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DEVELOPMENTS IN THE SOVIET ELECTRIC STEEL INDUSTRY

GROWTH OF ELECTRIC STEEL PRODUCTION

Stal', Vol VII, No 11, Nov 47

The rapid growth in the production of high-quality electric steel is shown by the following percentage figures on production of electric steel in the USSR during the years of the first and second five-year plans, with 1928-29 production at 100 percent:

	1928-1929	1929-1930	1931	1932	1933	1934	1935	1936	1937
Electric steel smelting (%)	100	189	370	545	1,047	1,855	2,845	4,660	4,590
Share of electric steel in total steel output (%)	0.38	0.60	1.22	1.70	2.81	3.55	4.20	5.25	4.80

During the last war, in the East, 16 electric steel smelting furnaces were put into operation. One of the most difficult wartime problems was the smelting of a number of alloy structural steels by the resmelting method using alloy waste products. As a result of work begun before the war at the "Elektrostal'" and "Dnepropspetsstal'" plants and continued during the war at the Kuznetsk and Zlatoust plants, the technology of smelting by the resmelting method was established and introduced into practice in the smelting of ball-bearing, chrome-nickel (medium-carbon and low-carbon grade 18 KhNM(V)A), stainless (EYal and EYalT), valve steel EI69, and others.

In resmelting chrome-bearing waste products, the utilization of the chromium of the charge is 60-80 percent in smelting steel with 1.3-2.5 percent chromium and 80-90 percent in smelting steels with 15-25 percent chromium. In resmelting waste products of tungsten steels, 80-90 percent of the tungsten remains in the metal. It is also possible to utilize 50-70 percent of the manganese, silicon, and vanadium of the charge.

During the postwar Five-Year Plan, 90 electric furnaces will be restored and built.

RESMELTING OF ALLOY WASTE PRODUCTS AT ELEKTROSTAL'

Stal', Vol VII, No 2, Feb 47

In 1944, 78 percent of all electric-smelted metal at the "Elektrostal'" Plant was produced by the improved method of resmelting alloy waste products in electric furnaces. In 1945, the proportion was 84.5 percent of all electric-smelted metal produced by the plant, as compared with only 43 percent in 1940.

The improvement in the resmelting method consists mainly in the correct choice of charge both as to chemical content and size, in the prevention of the metal's becoming impregnated with carbon of the furnace electrodes, in observing a definite slag regime, and in careful organization of the preparation of alloy waste products in sorting and storage. Meeting these conditions helps in making a precise determination of the charge and in obtaining a low carbon content in the steel when 50-60 percent alloy waste products, 20-30 percent soft iron, and 20-30 percent ferroalloys are used in the charge. In selecting the charge, it is most necessary to know precisely the chemical content of its metallic elements and of the ferroalloys. The charge material should be so selected that the entire charge (except for ferrovanadium which is added later) is charged simultaneously, lies compactly in the furnace, and contains no more than 20-30 percent of extremely large pieces.

In smelting the high-alloy tool steels ERF1 or EKh12M, the waste products of these steels are often not available in the stock yard, in which case waste products of steels similar to them in content should be selected. To decrease losses of valuable alloying elements (chromium, tungsten, vanadium) which are easily converted into oxides in the slag, waste products of steels containing deoxidizing elements (silicon and aluminum, EI340, 38KhMYuA, 30KhGSA, 35KhGSA, and others), are added to the charge, thus reducing the loss of the alloys from 10-12 to 6-8 percent.

In smelting structural alloy steels (12KhN3A, 12Kh2N4A, and 18KhNMA and others) with a carbon content of 0.10-0.18 percent, waste products and soft iron with a low carbon content are included in the charge. The plant can convert to smelting these steels by the resmelting method exclusively by eliminating the mixing of the waste products, organizing careful sorting of them according to carbon content, and careful marking and storage, particularly after the waste products of steels 12KhN3A, 18KhNMA, and 12Kh2N4A are separated from waste products of the corresponding high-carbon steels 20KhN3A, 25KhNMA, and 40KhNMA.

In smelting the stainless steels and alloys EYalT, EI319, EKhN60, and others similar to them by the resmelting method, the entire charge is closely controlled as to carbon content, while there should be no more than 0.05-0.06 percent carbon in the soft iron; each piece of the waste products must be marked, and the carbon content in each melt of 0000-grade ferrochrome must be checked. The order of charging must be followed closely: the soft iron is charged under the electrodes, ferrochrome and large stainless steel wastes on the sides, and on top, nickel and light-weight waste products. These conditions of smelting, together with the necessary slag regime, result in a carbon content of 0.13-0.14 percent for EYalT, 0.15-0.18 percent for EI319, and 0.14-0.15 for EKhN60.

Since 1945, the "Elektrostal'" Plant has used the resmelting method exclusively in smelting stainless steels of these grades. The output of steel has increased sharply, since the length of the melt under the new method has decreased by 2-2½ hours. Hundreds of tons of nickel and carbonless ferrochrome have been saved as a result of the recovery of alloys from stainless steel waste products.

Conversion to the new method in smelting almost the entire assortment of steels necessitated reorganization of the work of the stockyards and their expansion. All bins for waste products in the steel-casting and pile driver shops were cleaned out and prepared for storage of waste products of specific grades. All the scrap and waste products accumulated in former years were sorted and redivided (in all, nearly 6,100 tons, including 1,500 tons obtained from sources outside the plant). Waste products of the steel-casting shops are now marked as soon as they are formed and if they do not need further separation, are consumed in the charge of the same shop, thus eliminating the trip to the stock yards. Cuttings from the roughing division are sorted by grade and sent to the stock yards, where they are stored in special bins. Each shop has a special goal set each week for scrap and waste procurement.

In 1944-45, the adoption and development of the new method considerably increased the consumption of alloy waste products. The utilization of all waste products of current production and the re-sorting of old waste reserves have already failed to meet the plant's demand for waste products. Therefore, the plant has arranged to get them from Moscow city and oblast metalworking enterprises which have been inspected by plant workers. Since metalworking plants often mix alloy wastes, the plant has to maintain careful control over all waste products coming in from outside and must make careful analyses of them. Since the end of 1944, the volume of mixed wastes has decreased sharply as a result of fines imposed on offenders.

Thus, in 1944-45, the plant re-sorted and reconsumed nearly 1,000 tons of chrome-nickel waste products and 500 tons of chrome-silica waste products obtained on the outside. The plant regularly controls and stimulates the delivery of wastes from outside, and in this way, the flow of the necessary products in 1945 increased by 38 percent over 1944.

To provide a further increase in the utilization of waste products, their use, particularly scrap and furnace scale, has been made obligatory in the revised technological specifications for smelting steels of the following grades: EYa1T, EI319, EI100, EKhN60, EZh1-2, EI170, and others. For smelting tool steels, combined charges made up of from four to six various grades of waste products, with a minimum quantity of fresh ferroalloys, are used. Consumption of waste products of chromaluminum steels EI340 and EI341 (50 kilograms per ton of charge) in smelting grades ERF1, EI262, EI347, EI184 has helped not only to decrease the loss of tungsten and vanadium (as the result of preliminary deoxidation of the metal with aluminum), but also to recover chromium from them. In smelting steels containing molybdenum (EKh12M, E5KhNM, EI69, EI107, EI84, and others) by resmelting, it is obligatory to use waste products 35-38KhMYuA (approximately 100 kilograms per ton), recovering chromium and molybdenum from them.

Waste products of EI256 and EI94 steels, which have a high manganese content, are used to effect savings of ferromanganese in open-hearth and electric furnaces.

In 1944-45, all furnace scale and scrap of current production, and a considerable portion of the old furnace scale, were used in the open-hearth furnaces. Furnace scale of EI316, EYa3S, and EYa1T, all high-nickel steels,

was separated by pile driver and resmelted for smelting steels EI316 and EYa3S. The changed method of collecting scrap from under open-hearth furnaces made it possible to increase the consumption of chrome-nickel waste products to 50 percent.

As a result of technical and organizational measures, the plant increased the consumption of alloy waste products from 54.6 percent (of the charge) in 1944 to 60.8 percent in 1945. The plant is considerably exceeding the order from "Narkomchermet" (People's Commissariat of Ferrous Metallurgy) for obligatory consumption of 35-40 percent of nickel-bearing waste products in the smelting of nickel steels. At the same time, development of the method of resmelting has helped the plant to increase the productivity of electric furnaces by 7-8 percent, to decrease the length of the melt from 6.2 to 5.76 hours, and to decrease consumption of electric power from 1,003 to 929 kilowatt-hours per ton (data from shop No 1).

The increased utilization of alloy waste products in comparison with the plan and the full recovery of alloys from them in 1944-45 gave a substantial saving in consumption of ferroalloys and nickel:

Savings in Consumption of Ferroalloys and Nickel in Comparison With the Plan (tons)

Alloy	1940	1944	1945
Nickel	82.0	132.0	228.0
Ferrochrome	175.0	325.5	627.0
Ferrovanadium	0.6	70.7	99.4
Ferromolybdenum	4.3	6.1	3.5

In 1944-45, as a result of smelting steel by the method of resmelting waste products, the following quantity of alloys (converted to addition agents, in tons) were recovered from waste products and used: nickel, 1,135; ferrovanadium, 254, ferrotungsten, 1,013; and ferrochrome, 3,935. At the same time, actual norms for consumption of ferroalloys and nickel per ton of finished steel in ingots were considerably decreased:

Norms for Consumption of Ferroalloys and Nickel and 1940 and 1945 (kg/ton)

	Nickel		Ferrochrome		Ferro-tungsten		Ferro-vanadium		Ferro-molybdenum	
Steel	1940	1945	1940	1945	1940	1945	1940	1945	1940	1945
EYa1T	95.8	51.4	329.1	200.5	--	--	--	--	--	--
EI319	102.1	55.2	350.0	281.2	--	--	--	--	--	--
EI69	72.8	56.4	113.6	66.8	--	--	--	--	5.5	2.1
EKhN60	697.2	544.3	319.1	242.0	--	--	--	--	--	--
EI100	44.7	4.9	249.8	129.5	--	--	--	--	--	--
12KhN3A	13.3	9.4	9.0	6.7	--	--	--	--	--	--
EI181	--	--	531.0	508.5	--	--	--	--	--	--
ERF1	--	--	49.9	37.9	227.6	221.1	27.8	20.2	--	--
EI262	--	--	43.9	34.4	95.5	98.1	62.4	38.9	--	--

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The following table gives a comparison between the planned average content of alloys and the actual content in the melts in 1944:

Content of Alloys in Melts in 1944 (percent)

	Nickel		Chromium		Tungsten	
Steel	Planned	Actual	Planned	Actual	Planned	Actual
ERF1	--	--	4.2	4.11	18.25	18.11
EI262	--	--	4.3	4.34	9.25	9.04
EYa1T	8.75	9.07	18.0	17.97	--	--
EI316	12.0	11.79	24.0	23.55	--	--
EI107	--	--	10.0	9.78	--	--
ESKh8	--	--	9.0	8.60	--	--
EI69	14.0	13.68	14.0	13.73	2.40	2.36
EI6M	4.26	4.21	1.50	1.47	--	--
EI83	3.50	3.34	1.50	1.41	--	--

	Vanadium		Molybdenum	
Steel	Planned	Actual	Planned	Actual
ERF1	1.20	1.13	--	--
EI262	2.30	2.18	--	--
EYa1T	--	--	--	--
EI316	--	--	--	--
EI107	--	--	0.30	0.30
ESKh8	--	--	--	--
EI69	--	--	0.33	0.32
EI6M	--	--	0.35	0.32
EI83	--	--	--	--

The decrease in the average content of alloys in steels has also given considerable savings of ferroalloys and nickel in comparison with planned consumption (in tons): nickel, 15.2 tons; ferrochrome, 89.0 tons; ferrotungsten, 12.7; ferrovanadium, 16.8; and ferromolybdenum, 0.1

Conclusion

The technical and economic indexes obtained in smelting steels by the resmelting method prove the effectiveness of the method, particularly in the savings of ferroalloys. However, to maintain regular work by this method, the plant needs an organized supply of sorted and graded alloy waste products and requires that the steel-consuming enterprises ship out without delay the high-alloy waste products, particularly those containing tungsten, to the plants producing steels. The delivery of waste products of mild steel with low carbon content must also be organized. The increase in the demand for quality in alloy steels in regard to phosphorus and sulfur content demands that ferroalloy plants supply ferrochrome, ferrotungsten, ferrovandadium, and other ferroalloys with low phosphorus and sulfur content. To smelt low-carbon steels and alloys, the plants need a regular supply of graphitized electrodes of the highest grade.

Utilization of alloy waste products and dissemination of the method of resmelting open wide possibilities for an increase in the productivity of electric furnaces in the USSR and for savings of scarce ferroalloys.

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